

# AMERICAN MUSEUM NOVITATES

Number 717

Published by  
THE AMERICAN MUSEUM OF NATURAL HISTORY  
New York City

May 4, 1934

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59.7, 56 P

## AMBICOLORATION IN THE WINTER FLOUNDER, *PSEUDOPLEURONECTES AMERICANUS*

I.—INCOMPLETE AMBICOLORATION WITHOUT OTHER DEFORMITY

II.—COMPLETE AMBICOLORATION WITH A HOOKED DORSAL FIN  
AND WITH THE ROTATING EYE JUST OVER THE DORSAL RIDGE

BY E. W. GUDGER

### INTRODUCTION

The Pleuronectidae or flatfishes are normal abnormal forms. They are abnormal because instead of standing vertically in the water with the upper half of the body dark and the lower light, they lie on one side which is white and blind, while the upper side is colored and double-eyed. If only an occasional such specimen were found, it would be reckoned the greatest possible abnormal fish. But, since the flatfishes are among the commonest of our littoral forms and since all normally correspond to the specifications above, no one ever thinks of them as abnormalities. However, they are teratological fishes which in their own group are entirely normal. This is a point that has never been particularly emphasized.

Flatfishes normally lie on one particular side (right or left according to genus and species) and have eyes and color on the other, except chiefly the flounders (the little specialized forms) with which it is almost a matter of indifference. Any departures from these normal characters constitute such a specimen an abnormal pleuronectid. These departures are of two kinds: (1) the lying on the wrong side (i.e., on the right side when the left is the rule for the genus) with eyes and color on the wrong side; or (2) while lying on the normal side, having color or the absence of it on the wrong side, with or without an abnormally placed rotating eye and a hooked dorsal fin, or both. Flatfishes of the first kind are called "reversed" fishes, and those having color on the under side are known as "ambicolorate" or double colored (i.e., colored on both sides).

There are in the collections of the Department of Ichthyology of the American Museum two undescribed specimens of our common winter flounder: one having simple or uncomplicated ambicoloration on the under side, the other almost wholly dark below and having the rotating eye stopped just across the dorsal ridge and overhung by the anterior hooked end of the dorsal fin.

About such flatfish abnormalities a considerable literature has arisen in western Europe, but only two distinctive articles and four incidental notices on such anomalies in American forms have been published. Hence it may be of interest and value to figure, describe, and briefly discuss our two specimens.

Furthermore, this article will serve as an appropriate introduction to two others on these abnormal fishes on which I have been engaged for nearly a year. In these will be brought together all the data known on ambicoloration without or with other anomalies. The subject is vast and at present in a most chaotic condition, but in these articles I hope

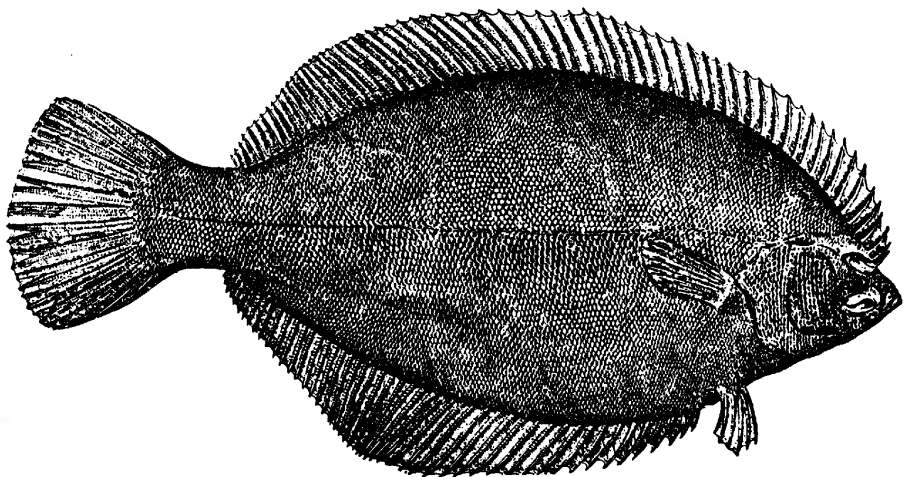


Fig. 1. Upper surface of a normal winter flounder, *Pseudopleuronectes americanus*.

After Jordan and Evermann, 1900.

to bring the data into order and to show how increasing ambicoloration is accompanied in extreme forms by eye and fin anomalies, and to work out in such forms a definite gradation from the simplest to the most complicated abnormalities. This has never been undertaken before.

However, before taking up the abnormal forms, it will be well to present as figure 1 a drawing of the upper or right surface of a normal *Pseudopleuronectes americanus*. This is copied from Jordan and Evermann's 'Fishes of North and Middle America,' Washington, 1900, volume IV, Pl. cccclxxix, fig. 933. From this figure it will be clear why I have emphasized the fact that a flatfish is a normal teratological fish. From this normal specimen let us now proceed to the teratological forms.

## I.—A SIMPLE OR INCOMPLETELY AMBICOLORATE

*Pseudopleuronectes americanus*

This specimen was found in a small fish market at Seventy-fifth Street and Broadway, New York City, in July, 1931, by Mr. Charles R. Knight, the well known animal painter. Recognizing the interesting abnormality, he purchased the fish, and kindly presented it to the Museum. Presumably this specimen came from the waters around New York, where the species is abundant. Its range is from Labrador to Virginia, and sparingly as a straggler farther south. This specimen measures 14 in. to the base of the caudal fin (standard length) and 17 in. over all. Its depth is 5.75 in. and its weight is 1.5 lbs. It is then an adult.

On the upper or right-hand surface of this ambicolorate specimen there is nothing abnormal to be seen. The eyes are in their usual position, there is no notch at the point where the dorsal meets the head, and the lateral line ends under the fourth dorsal spine. The fish might have been the normal one from which the upper aspect figured in Jordan and Evermann's plate was drawn. It must be emphasized then that in the ordinary ambicolorate flatfish, there is nothing on the upper surface to indicate that such a fish is in any wise abnormal.

When, however, one turns to the lower or left surface an entirely different situation is presented. The fish was in bad state before preservation—the scales and epidermis being partly gone from both surfaces and the viscera removed. However, in general, the two sides are alike dark in color, with the following exception: the whole under surface of head and operculum is white, as is also the whole shoulder region above and behind the head and the operculum and the left pectoral fin; this white region or patch extends backward to the 17th dorsal ray and then is delimited from the posterior dark area by an irregular line extending downward to and under the hinder part of the pectoral fin. The region immediately above and behind the base of the fin is dark. This is shown clearly in figure 2.

Other than this white head, operculum, and shoulder region, the whole lower surface is as dark as the upper, but there are no other abnormalities save a fragment of what appears to be lateral line on the head just below the nostril. The lateral line proper ends under the sixth dorsal spine and there are neither spines nor rough scales on the under side such as have been noted on other ambicolorate specimens. The left eye has been carried clear across the mid-dorsal line onto the right surface of the head, to its normal position as seen in figure 1, and is not visible from below.

Other known reports of abnormalities of *Pseudopleuronectes americanus* are but three. It is stated (Anon. 1901) on the authority of the late Vinal N. Edwards that in February, 1900, he obtained a reversed specimen, the only one in his long years of collecting at Woods Hole. H. C. Bumpus is also quoted (1898) as reporting that in the winter of 1898-1899 great numbers of "black bellies" (i.e., piebald on lower side)

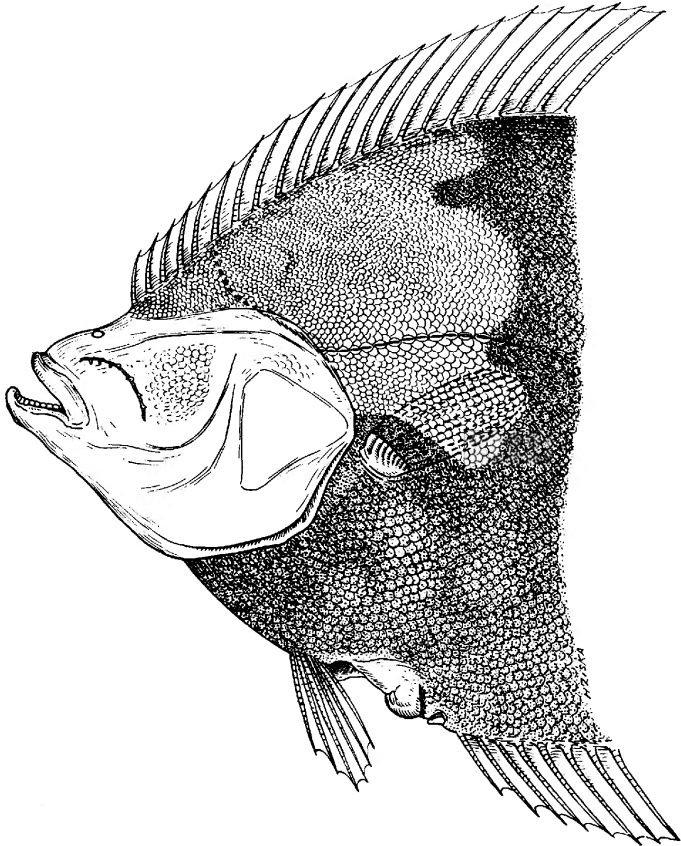


Fig. 2. Lower or blind surface of an incompletely ambicolorate winter flounder in the collections of the American Museum.

were taken in Greenwich Bay, Rhode Island, and that in 1900 a few 7 and 8-in. specimens were taken at Waquoit. V. N. Edwards reported that these were the first abnormally colored winter flounders he had seen in thirty years seining there. From this one must conclude that this flounder is little given to variation.

So far as I know, there are only two other references to simple ambicolorate American pleuronectids (but not winter flounders). Hus-

sakof, in 1914, described two incompletely ambicolorate specimens of the summer flounder, *Paralichthys dentatus*, from Cape Lookout, North Carolina. And in 1921, Banta described a number of young unidentified flatfish from Cold Spring Harbor, north shore of Long Island. Consideration of all these specimens will be given in the first of the two general papers on ambicolorate flatfishes on which I am now at work.

## II.—COMPLETE AMBICOLORATION WITH A HOOKED DORSAL FIN AND WITH THE ROTATING EYE JUST OVER THE DORSAL RIDGE

The interesting specimen now to be studied came to my attention through the kind offices of Mr. J. A. Weber of New York City, and was presented to the Museum by its captor, Mr. Emile Klee, also of New York City.

On April 14, 1931, while fishing in Goose Creek, Jamaica Bay, Long Island, with hook and line and using a sandworm for bait, Mr. Klee caught the fish under consideration. When brought in, its captor at first noticed nothing unusual about the fish, but on turning it over he found the lower surface dark instead of white. Then the hooked front end of the dorsal fin attracted his attention. He had never seen such a flounder in all his thirty-five years' experience as a fisherman, so he called his companions to examine it and, in his own words, "to see whether there was something wrong with my eyes or with the fish."

This is a small specimen of the common winter flounder, measuring 7.5 in. long to the base of the caudal and 9.25 in. over all. Its depth is 3.4 in., and its weight 4.75 oz. This is, then, a young fish, probably about three years old.

This fish is abnormal in four respects: it is ambicolorate—the lower surface is colored like the upper side; the left eye was arrested in its rotation just after it crossed the dorsal crest; it has the hooked dorsal fin often associated with these other anomalies; and lastly, there are certain abnormal branches of the anterior end of each lateral line.

The normal color is dull brown above and white below. Our specimen had had most of the scales removed from both sides of the body before it was presented to the Museum, but being in good condition it is clear upon examination that its color was that common to the species. The whole lower surface is of exactly the same color as the upper save that the anterior half of the head lacks pigment (Fig. 4). How white it was in life cannot be said, since it was brought to me in formalin, but at the present time this patch is yellowish white. The scales were not removed from head and shoulders and hence show in the drawings—

figure 3, from the right or upper surface, and figure 4, from the left or lower side, showing the white patch.

The upper or right surface presents two abnormalities in the head region. Most apparent is the fact that the left eye has not rotated wholly to the right side, as is shown in figure 3. The left-hand rim of the eye lies in the mid-dorsal region, and this edge (but not the pupil) is visible when one looks at the fish from the left side, as may be seen in figure 4. Of equal interest is the abnormal dorsal fin—with a notch at its anterior base. This notched fin overhangs the hinder edge of the left rim of the eye.

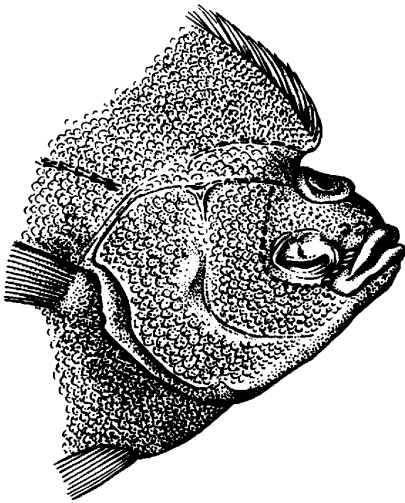


Fig. 3

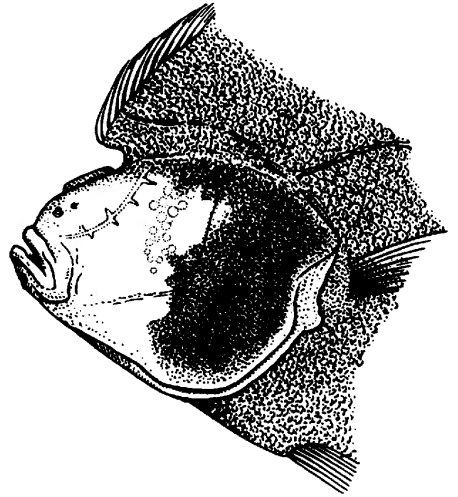


Fig. 4

Fig. 3. Upper surface of the head of a practically ambicolorate winter flounder in the collections of the American Museum, to show the incompletely rotated eye and the hooked dorsal fin.

Fig. 4. Lower head region of the same specimen.

The other abnormality is to be found in the anterior end of the right lateral line. At the upper hinder edge of the operculum the lateral line divides. The upper branch arches up slightly and runs forward to the base of the dorsal fin. The other curves around the upper limit of the opercular region, then swings down behind and underneath the right eye and ends behind and on a level with the opening of the mouth.

On the under or left surface, as shown in figure 4, it is seen that the anterior half of the head and opercular region are white. The hinder half (in a rough semicircle) is darker even than the remainder of the lower side of the fish. At the edge of the upper limit of the white area,

the left edge of the left eye may be seen. On the left side as on the right, the lateral line shows some abnormalities. After making the same gentle curve over the base of the pectoral fin, at the same spot as on the right side (as ascertained by driving a pin through the head), the lateral line curves upward and forward to end under the base of the fourth dorsal fin ray. I am unable to make out a lower branch of the lateral line as on the right side, but on the upper part of the white area there is a curious structure with blunt lateral outpushings which I interpret as a malformed section of the lower branch of the lateral line. This recalls a similar fragment on the under side of the head of the first fish—see figure 2. Diagonally behind and below this is a patch of curious structures which I take to be the bases of abortive scales. There are no scales present, these are impressions in the integument.

The most marked abnormality of all is of course the hooked dorsal. This seems to have been the result of the incomplete translation of the left eye to the right side. The disturbances connected with this have also probably had much to do with the abnormalities of the lateral line. Furthermore, this hooked dorsal seems tied up closely with the degree and extent of the pigmentation of the under or left surface.

Comparison should be made, at this point, of the large amount of pigment on the under side of the head of fish No. II, with the sparse amount on that of No. I. Not only is the whole lower body of fish No. II as darkly and densely pigmented as the upper surface, but practically all the opercular region (except the outer hinder and lower edges) is heavily pigmented, also the upper part of the head; the median ridge and the lower jaw are slightly pigmented. Fish No. I (Fig. 2) not only has head and operculum but also the whole shoulder region colorless. No. II has the eye and dorsal fin anomalies which go with extreme ambicoloration, while in these organs No. I is as normal as a white-bellied fish.

There are in the literature known to me but two references (both incidental) of such abnormalities in American pleuronectids as those described above for fish No. II. As early as 1815, Mitchell incidentally described an abnormal "black-bellied" flounder, which he appropriately (as he thought) named *Pleuronectes melanogaster* (probably *Paralichthys dentatus*). This has "the belly . . . almost as dark colored as the back; the hue—a shade lighter." The rotating eye was barely over the dorsal ridge and the dorsal fin was hooked in front. His specimen then was practically a duplicate of mine.

Lastly, Storer (1844) described an ambicolorate *Platessa oblonga* (*Paralichthys lethostigmus*?) colored on both sides. The rotating eye

was "directly on top of the head," and the dorsal fin was hooked. This was not only described but figured in his paper of 1863, and in his book of 1868. This fish and that described by Mitchill will be considered again and more fully in the second paper in progress—i.e., that on complete ambicoloration.

It does not seem well in this short paper to discuss the amount and the cause of ambicoloration in flatfishes, nor to endeavor to find an explanation for the abnormally placed eye and for the hooked dorsal fin. We must first have under our feet all the known facts. For simple ambicoloration, these facts will, in all cases known to me, be brought together in the first of the papers on which I am engaged, in an effort to ascertain how far forward the dark color may advance on the under side without any head abnormalities being found. Then all the causes alleged for this phenomenon will be discussed.

In the second paper, the far greater number of accounts dealing with complete ambicoloration and the accompanying head anomalies will be classified and studied, and then an endeavor will be made to explain the partly rotated eye and the hooked dorsal fin. This has proved to be an exceedingly difficult task, but there is some light ahead.

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